Closing urban resource cycles through nature-inspired systems

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The present-day urban system is characterised by a one-directional flow of resources from the rural environment into cities. Cities are centres of human and economic activity, but also of resource use and waste. Therefore, they play both a critical and promising role to support the transition to a circular economy, by keeping incoming products, materials and resources in use. This requires a redesign of biological and technical material cycles in a way that their value can be maintained at the highest possible level for as long as possible, while at the same time natural systems are restored. How can we rethink urban infrastructures to transform cities from resource sinks into circular resource transformation hubs? And how can nature-inspired systems help us to create circular cities?

alchemia-nova is developing integrated, regenerative systems to close water, nutrient, material and energy cycles in cities, centred around buildings as multifunctional service providers. They include building-integrated nature-based solutions for small-scale on-site wastewater treatment, combined with organic solids management to platform chemicals, biogas and nutrients. This approach can enable the efficient valorisation of the high resource potential of urban nutrient flows, with near zero-energy and chemical input. This way, they provide a more efficient, robust and resilient alternative to the predominant chemical and energy-intensive end-of-pipe approaches to circular cities. Water and nutrients can be safely reused in urban and peri-urban agriculture, renewable energy produced on site, biomass and other solid waste further processed to secondary materials, while also gaining the multifunctional benefits of urban greening. These systems are being demonstrated through the EU H2020 HOUSEFUL project in Austria and Spain, complimented by demonstration sites in Greece (EU H2020 HYDROUSA project), thus ensuring their applicability in highly industrialised infrastructure and temperate climatic conditions, as well as in less developed communal infrastructure and Mediterranean arid climatic conditions. HOUSEFUL's integrated management approach includes circular materials management along the entire housing value chain, e.g. to enable local sourcing of building materials. Together, the robust, low-maintenance technologies and circular materials management contribute to the creation of distributed resource transformation hubs across cities, where value is maintained, and secondary resources captured and recirculated where they occur, creating more efficient and more resilient circular cities, and a wider circular economy.

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